IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re PATENT application of:

Applicant(s): Christopher A. Spence
Serial No: 09/515,348
Filed: February 29, 2000
Title: METHOD FOR EVALUATION OF RETICLE IMAGE USING AERIAL IMAGE SIMULATOR

Examiner: Brian P. Werner
Art Unit: 2621

Docket No. F0039 (AMDSP0388US)

APPEAL BRIEF

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

The undersigned submits this brief for the Board's consideration of the appeal of the Examiner's decision, mailed June 28, 2005, finally rejecting claims 1, 4-20 and 22-27 of the above-identified application. A payment by credit card covering the fee for filing this brief is included.

I. Real Party in Interest

The real party in interest in the present appeal is Advanced Micro Devices, Inc., the assignee of the present application.

II. Related Appeals and Interferences

Neither appellant, appellant's legal representative, nor the assignee of the present application are aware of any appeals or interferences, which will directly affect, which will be directly affected by, or which will have a bearing on the Board's decision in the pending appeal.

III. Status of Claims

Claims 1, 4-20 and 22-27 were finally rejected. However, an amendment under 37 CFR 1.116 was submitted, and entered for purposes of appeal by the Examiner in the Advisory Action, mailed November 4, 2005. The amendment under 37 CFR 1.116 cancelled claims 1, 4, 22, 23 and 27. Accordingly, claims 1-4, 21-23 and 27 have been cancelled, while claims 5-20 and 24-26 are the subject of this appeal. A correct copy of the claims 5-20 and 24-26 is reproduced in the Claims Appendix.

IV. Status of Amendments

As above noted, an amendment under 37 CFR 1.116 was submitted prior to the filing of this brief. The Examiner entered this amendment for purposes of appeal, as set forth in the Advisory Action, mailed November 4, 2005.

V. Summary of Claimed Subject Matter

The following is a concise explanation of the subject matter defined in the single independent claim involved in this appeal, which refers to the specification by page and line number, and to the drawing by reference characters.

Claim 25

A method of analyzing a mask manufacturing process [p. 6, ln. 12; p. 19, ln. 11] includes imaging 510 at least a portion of a mask to be used in a wafer structure formation process [p. 6, ln. 13; pg. 21, ln. 22] , simulating 530 lithographic processing using data received from or derived from the imaging of the portion of the mask, thereby obtaining a first simulated wafer structure [p. 6, ln. 14; p. 8, ln. 20], and simulating 540 lithographic processing using mask design data corresponding to the imaged portion of the mask as an input, thereby obtaining a second simulated wafer structure [p. 8, ln. 23]. The first simulated wafer structure is compared 550 to the second simulated wafer structure [p. 5, ln. 2; p. 17, ln. 17], and the first and second simulated wafer structures are compared to an ideal wafer structure [p. 5, ln. 6; p. 19, ln 13]. Based on the comparing steps, critical dimension variations across the wafer structure are evaluated 560 [p. 9, ln. 1].

VI. Grounds of Rejection to Be Reviewed on Appeal[1]

A. Claims 5-8, 10, 11, 13-15, 17-20 and 24-26 stand finally rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang et al. in view of Fiekowsky.

B. Claims 8, 9 and 13-20 stand finally rejected under 35 U.S.C. § 103(a) as being unpatentable over Pierrat et al. in view of Fiekowsky.[2]

C. Claims 10-12 stand finally rejected under 35 U.S.C. § 103(a) as being unpatentable over Pierrat et al. and Fiekowsky in view of Sheng.[3]

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[1] The amendment under 37 CFR 1.116, which was entered for purposes of appeal, cancels claims 1, 4, 22, 23 and 27, thereby rendering moot the final rejection of said claims under 35 U.S.C. § 103(a). The amendment under 37 CFR 1.116 placed previously dependent claim 25 in independent form and amended other claims to depend from now independent claim 25.

[2] In light of the amendment under 37 CFR 1.116, which was entered for purposes of appeal, claims 8, 9 and 13-20 ultimately depend from independent claim 25 (with or without intervening dependent claims). The final office action, mailed June 28, 2005, is not understood to reject claim 25 based on Pierrat et al. In essence, the amendment under 37 CFR 1.116 renders moot this rejection of claims 8, 9 and 13-20.

[3] In light of the amendment under 37 CFR 1.116, which was entered for purposes of appeal, claims 10-12 ultimately depend from independent claim 25 (with or without intervening dependent claims). The final office action, mailed June 28, 2005, is not understood to reject claim 25 based on Pierrat et al. In essence, the amendment under 37 CFR 1.116 renders moot this rejection of claims 10-12.

VII. Argument

The rejections advanced by the Examiner are improper and should be reversed for at least the following reasons.

A. Rejection of Claims 5-8, 10, 11, 13-15, 17-20 and 24-26 under 35 U.S.C. § 103(a) over Chang et al. in view of Fiekowsky

Now independent claim 25 and claims 5-8, 10, 11, 13-15, 17-20, 24 and 26 dependent therefrom stand finally rejected under 35 U.S.C. § 103(a) as being unpatentable over Chang et al. in view of Fiekowsky.

Independent claim 25 and dependent claims 5-8, 10, 11, 13-15, 17-20 and 26

Claim 25 recites a method of analyzing a mask manufacturing process that includes simulating lithographic processing using data received from or derived from imaging of a portion of a mask and mask design data, thereby obtaining first and second simulated wafer structures. The first and second simulated wafer structures are compared to each other and to an ideal wafer structure. Critical dimension variations across the wafer structure are evaluated based on the comparing steps.

The invention recited in claim 25 compares first and second simulated wafer structures to each other and to an ideal wafer structure, and evaluates the critical dimension variations across the wafer structure to analyze the effect that a particular mask making process has on a wafer structure formation process.

Neither Chang nor Pierrat, taken alone or in combination, discloses or fairly suggests comparing first and second simulated wafer structures (corresponding to mask image data and mask design data, respectively) to each other and to an ideal wafer structure. The deficiencies of these primary references are not cured by Fiekowsky or Sheng.

In support of the rejection, the Examiner asserts that:

> [r]egarding claim 25, Chang anticipates comparing the two simulated wafer structures to ideal wafer structure (figure 20, mask image simulation 2020 and design data simulation 2050 are displayed, their difference is displayed at 2030, and the original design data is displayed at 2040.[4]

As best understood, the Examiner is asserting that the "original design data 2040" disclosed in Chang et al. is equivalent to the "ideal wafer structure" recited in claim 25. It is respectfully submitted that a closer reading of Chang reveals that this interpretation of Chang is incorrect.

At col. 26, lines 49-51, Chang et al. states that "[w]indow 2040 illustrates the original design layout *of the captured mask image* of window 2010." (Emphasis added). Chang et al. further discloses that "[w]indow 2050 illustrates the simulated wafer exposure of the original design layout of window 2040." In other words, Chang is understood to disclose that window 2040 corresponds to the mask design data and window 2050 corresponds to a simulation of the mask design data, which is compared to window 2020 (simulation of the captured microscope image of a portion of the mask).

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[4] Page 6 of the final Office Action, dated June 28, 2005.

Even assuming *arguendo* that Chang et al. suggests comparison of two simulations (corresponding to mask image data and mask design data, respectively), this portion of Chang et al. does not disclose or fairly suggest comparing the two aforementioned simulations to an ideal wafer structure, as is recited in claim 25.

In addition, it is generally understood in the art that "original design layout of the captured mask image" (i.e., mask design data) is not equivalent to an "ideal wafer structure." For example, mask design data generally would include optical proximity correction (OPC) modifications, while an ideal wafer structure (or data corresponding thereto) would not include such OPC modifications.[5]

Further, neither Chang et al. nor Pierrat et al., taken alone or in combination with Fiekowsky and/or Sheng, disclose or fairly suggest analyzing a mask manufacturing process by evaluating critical dimension variations across a wafer structure. Rather, Chang et al. and Pierrat et al. are concerned with inspecting photomasks to locate specific or localized defects on the mask. While Fiekowsky deals with feature measurement, it contains no suggestion to analyze a mask manufacturing process by evaluating critical dimension variations across a wafer structure.

For at least these reasons, it is respectfully submitted that claim 25 and claims 5-8, 10, 11, 13-15, 17-20 and 26 dependent therefrom distinguish patentably over the references of record. Accordingly, the rejections should be withdrawn.

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[5] See, for example, col. 4, lines 4-30 of Chang et al. for a general discussion of using optical proximity corrections (OPC).

Claim 24

Claim 24 depends from claim 25 and, accordingly, the arguments presented above in relation to claim 25 are equally applicable to claim 24. In addition, claim 24 recites forming at least one of the first and second simulated wafer structures at various stages of the wafer structure formation process, and overlaying all of the simulated wafer structures on a display screen.

In support of the rejection of claim 24, the Examiner asserts that:

> [r]egarding claim 24, Chang overlays the simulated wafer structures on a display screen (comprises "displaying the images 970 and 975, and displaying the differences between the two such that an operator can visually detect any differences" at column 21, line 14; see figures 17 and 20).[6]

This rejection seems to ignore one or more of the elements recited in claim 24, such as forming at least one of the first and second simulated wafer structures at various stages of the wafer structure formation process, and overlaying all of the simulated wafer structures on a display screen.

Chang et al. fails to disclose or fairly suggest forming at least one of the first and second simulated wafer structures at various stages of the wafer structure formation process, and overlaying all of the simulated wafer structures on a display screen.

Even assuming *arguendo* that Chang et al. discloses comparing simulated wafer structures on a display screen, this disclosure is insufficient to render obvious claim 24.

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[6] Final Office Action, mailed June 28, 2005, pages 5-6.

Further, none of Fiekowsky, Pierrat et al. and Sheng, taken alone or in combination, cure the deficiencies of Chang et al. with respect to claim 24.

For at least these reasons, and the reasons set forth above with respect to claim 25, it is respectfully submitted that claim 24 distinguishes patentably over the references of record. Accordingly, the rejection should be withdrawn.

Claim 12 and claims 5-6 dependent therefrom

Claim 12 depends from claim 25 (including other intervening dependent claims) and, accordingly, the arguments presented above in relation to claim 25 are equally applicable to claim 12. In addition, claim 12 recites providing a user an option of selecting a figure of merit (FOM) by which critical dimension variations between the simulated structures are to be calculated.

It is noted that the only rejection of claim 12 stated in the final Office Action, mailed June 28, 2005, was based on a prior presentation of claim 12 that did not depend from claim 25.

In the interest of completeness, and only for purposes of this Appeal Brief, page 4 of the final Office Action, mailed June 28, 2005, will be discussed as if it includes a rejection of claim 12, where claim 12 depends from claim 25.

At page 4 of the final Office Action, mailed June 28, 2005, the Examiner acknowledges that Chang et al. fails to disclose or fairly suggest providing a user an option of selecting a figure of merit (FOM) by which critical dimension variations

between simulated wafer structures can be calculated. The Examiner seems to point to Fiekowsky to cure the deficiencies of Chang et al.

It is respectfully submitted that Fiekowsky would not lead the skilled artisan to modify Chang et al. to arrive at the invention recited in claim 12. While Fiekowsky may deal with feature measurement, it fails to make any mention of simulated structures, let alone disclosing or suggesting providing a user an option of selecting a figure of merit (FOM) by which critical dimension variations between simulated wafer structures can be calculated. Instead, Fiekowsky is understood to be concerned with an automatic measurement tool for measuring features on a physical mask. Without any contemplation of simulating wafer structure, Fiekowsky cannot reasonably be expected to attract the attention of a skilled artisan for combination with Chang et al.

For at least these reasons, and the reasons set forth above with respect to claim 25, it is respectfully submitted that claim 12 distinguishes patentably over the references of record. Accordingly, if it was intended for claim 12 to be rejected over Chang et al. in view of Fiekowsky, this rejection should be withdrawn.

B. Rejection of Claims 8-9 and 13-20 under 35 U.S.C. § 103(a) over Pierrat et al. in view of Fiekowsky

As discussed above in footnote 2, in light of the amendment under 37 CFR 1.116, which was entered for purposes of appeal, claims 8, 9 and 13-20 ultimately depend from independent claim 25 (with or without intervening dependent claims). The final office action, mailed June 28, 2005, is not understood to reject claim 25 based on

Pierrat et al. In essence, the amendment under 37 CFR 1.116 renders moot this rejection of claims 8, 9 and 13-20. If the Examiner is of a different understanding, he is invited to clarify the rejections within the final Office Action.

C. Rejection of Claims 10-12 under 35 U.S.C. § 103(a) over Pierrat et al. in view of Fiekowsky

As discussed above in footnote 3, in light of the amendment under 37 CFR 1.116, which was entered for purposes of appeal, claims 10-12 ultimately depend from independent claim 25 (with or without intervening dependent claims). The final office action, mailed June 28, 2005, is not understood to reject claim 25 based on Pierrat et al. In essence, the amendment under 37 CFR 1.116 renders moot this rejection of claims 10-12 If the Examiner is of a different understanding, he is invited to clarify the rejections within the final Office Action.

VIII. Conclusion

In view of the foregoing, it is respectfully submitted that the claims are patentable over the applied art and that the final rejection should be reversed.

This brief is being submitted along with a payment by credit card in the amount of $500.00 to cover the fee set forth in 37 CFR 41.20(b)(2).

Should a petition for an extension of time be necessary for the timely filing of this brief (or if such a petition has been made and an additional extension is necessary) petition is hereby made and the Commissioner is authorized to charge any fees to Deposit Account no. 18-0988, Order No. F0039.

Respectfully submitted,

RENNER, OTTO, BOISSELLE & SKLAR, L.L.P.

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IX. Claims Appendix

Claims on Appeal

5. The method of claim 12, wherein the FOM is a line width.

6. The method of claim 12, wherein the FOM is a percentage difference in overall area of the first and second simulated structures.

7. The method of claim 25, where first and second simulated wafer structures are obtained by the same simulation method.

8. The method of claim 25, where first and second simulated wafer structures are obtained by aerial image simulation.

9. The method of claim 25, where first and second simulated wafer structures are obtained by different simulation methods.

10. The method of claim 25, further comprising displaying the first simulated wafer structure on a display screen.

11. The method of claim 10, further comprising displaying the second simulated wafer structure on the display screen, wherein the first and second simulated wafer structures at least partially overlap with one another.

12. The method of claim 11, providing a user an option of selecting a figure of merit (FOM) by which critical dimension variations between the simulated wafer structures are to be calculated.

13. The method of claim 25, wherein the imaging includes using a scanning electron microscope (SEM) to obtain an SEM image.

14. The method of claim 13, further comprising transforming the SEM image into computer-readable data.

15. The method of claim 14, wherein the transforming includes applying an image analysis algorithm to the image data.

16. The method of claim 14, further comprising scaling the data.

17. The method of claim 25, further comprising transforming data of a first type, obtained in the imaging, into data of a second type, to be used in the simulating.

18. The method of claim 25, wherein the simulating includes aerial simulation using a computer program.

19. The method of claim 18, wherein the simulating also includes simulating the developed resist image.

20. The method of claim 25, wherein the simulating includes simulating using an aerial image microscope system.

24. The method of claim 25, further comprising forming at least one of the first and second simulated wafer structures at various stages of the wafer structure formation process, and overlaying all of the simulated wafer structures on a display screen.

25. A method of analyzing a mask manufacturing process, the method comprising:

imaging at least a portion of a mask to be used in a wafer structure formation process;

simulating lithographic processing using data received from or derived from the imaging of the portion of the mask, thereby obtaining a first simulated wafer structure;

simulating lithographic processing using mask design data corresponding to the imaged portion of the mask as an input, thereby obtaining a second simulated wafer structure;

comparing the first simulated wafer structure to the second simulated wafer structure;

comparing the first and second simulated wafer structures to an ideal wafer structure; and

based on the comparing steps, evaluating critical dimension variations across the wafer structure.

26. The method of claim 25, further comprising determining a location of greatest critical dimension variation between the first and second simulated wafer structures.

X. Evidence Appendix

None.

XI. Related Proceedings Appendix

None.